

Doc  
FAA  
AM  
93  
09

Doc  
FAA  
AM  
93/09

1. Report No. DOT/FAA/AM-93/9		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Accident Proneness: A Research Review			5. Report Date May 1993		
			6. Performing Organization Code		
7. Author(s) Mark D. Rodgers, Ph.D., and Robert E. Blanchard, Ph.D.			8. Performing Organization Report No.		
9. Performing Organization Name and Address FAA Civil Aeromedical Institute P.O. Box 25082 Oklahoma City, OK 73125			10. Work Unit No. (TRAVIS)		
			11. Contract or Grant No.		
12. Sponsoring Agency name and Address Office of Aviation Medicine Federal Aviation Administration 800 Independence Avenue, S.W. Washington, DC 20591			13. Type of Report and Period Covered		
			14. Sponsoring Agency Code		
15. Supplemental Notes					
16. Abstract Accident proneness is a concept that refers to an enduring or stable personality characteristic that predisposes an individual toward having accidents (Haddon, Suchman, and Klein, 1964). The concept is controversial and has sustained a lively debate in the literature over the past 75 years. For the most part, though, continual interest has been fueled by poor experimental procedures, misinterpretation of previously reported results, the need to assign blame to individuals, and a rather curious doggedness in attempting to establish a relationship between accidents and personality traits, despite the lack of supporting scientific evidence. This paper reports the origins of the notion of accident proneness and reviews the studies that purport to support or refute it.					
17. Key Words Accident Proneness, Personality Traits, Accidents, Prediction, Literature Critiques			18. Distribution Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 7	22. Price

# ACCIDENT PRONENESS: A RESEARCH REVIEW

## INTRODUCTION

### Background

Accident proneness is a concept that refers to an enduring or stable personality characteristic that predisposes an individual toward having accidents (Haddon, Suchman, and Klein, 1964). The concept is controversial and has sustained a lively debate in the literature over the past 75 years. For the most part, though, continual interest has been fueled by poor experimental procedures, misinterpretation of previously reported results, the need to assign blame to individuals, and a rather curious doggedness in attempting to establish a relationship between accidents and personality traits, despite the lack of supporting scientific evidence. This paper reports the origins of the notion of accident proneness and reviews the studies that purport to support or refute it.

### Early Studies

It all began during World War I with Greenwood and Woods (1919), who studied workers at a British munitions factory and found that accidents were not evenly distributed among workers, but that a relatively small proportion had most of the accidents. In an effort to explain this phenomenon, they suggested the notion of unequal initial liability, a concept that later came to be called "accident proneness." This investigation involved the comparison of observed accident frequency with the accident frequency that would be expected by chance alone. Greenwood and Woods also performed checks across consecutive time periods for these variables and found what they reported as positive correlations, which led them to propose the presence of individuals with unequal liabilities as the best explanation of their findings.

In spite of relatively careful experimental procedures, these investigators arrived at the unfounded conclusion that, "So far as our present knowledge goes, it seems that the genesis of multiple accidents under uniform external conditions is an affair of personality..." Remarkably, they reached this conclusion without any specific study of the personalities of the individuals whose accidents they tabulated.

Later, Newbold (1926), followed up on the work of Greenwood and Woods and studied the accident records of a large group of workers in 13 factories. Like Greenwood and Woods, Newbold found that a small number of workers contributed more than their share of accidents. She also concluded that this finding was indicative of a stable personality characteristic. However, Newbold carefully pointed out that, "It is not possible in a mass examination of this kind to find out how much of this may be due to individual differences in the conditions of work or how much to personal tendency, but there are many indications that some part, at any rate, is due to personal tendency."

Nonetheless, despite Newbold's caveat and careful phrasing with respect to "personal tendency," her work was often cited as offering proof of the existence of individuals who are psychologically prone to accidents (Haddon, and co-authors, 1964).

### Later Studies

The actual psychological construct of accident proneness evolved from the work of Farmers and Chambers (1939), who utilized the statistical observations of Greenwood and Woods (1919) and Newbold (1926) to formulate a formal theoretical description of the accident-prone individual in psychological terms. Farmers and Chambers

attempted to show that unequal liability could be explained by significant differences in personality traits between "accident-free" and "accident-prone" groups. These investigators assembled a set of "personality" tests, which consisted of aesthetokinetic (perceptualmotor), intelligence, mechanical aptitude, and perseveration measures. Correlational analysis on a group of 128 bus drivers over a five-year period yielded low, positive correlations, none of which was significant. The data on the psychomotor test were then ordered according to interquartile groups for each of the five years for which accident data were available, and mean differences between top and bottom interquartile groups were tested for each year. Statistically-significant differences were found between groups at the  $p < .05$  level for years 3, 4, and 5. Farmers and Chambers then concluded that, "Accident proneness is no longer a theory but an established fact." They asserted further that if the psychomotor test were used in screening driver applicants, the future accident rate would be reduced. However, they made no attempt to validate this assertion.

Farmers and Chambers proceeded further, asserting that, "Accident proneness was shown to manifest itself in all kinds of accidents and throughout all conditions of exposure," a supposition that was not supported by their data. Their study did not adequately document whether the quality and quantity of the exposure of the various groups were the same, and they made the unwarranted interpretation that differences between groups were due to stable psychological characteristics. This was in spite of their finding that the tests used were of doubtful validity with only one, aesthetokinetic (which can hardly be considered a personality measure), showing statistical significance.

In a later writing however, Chambers seemed to have second thoughts about their previous assertions (Chambers and Yule, 1941); however, like Greenwood and Woods, and Newbold before them, only their conclusions were recalled and quoted in later years by numerous individuals intrigued with the notion of being able to screen "accident prone"

individuals from the workforce. Such misinterpretation of findings contributed significantly to the development of a folklore surrounding the notion of accident proneness that has little correspondence to the evidence upon which it is said to be based. As additional personality tests were used in subsequent studies, contradictory and confusing results called to question the accident-proneness concept proposed by Farmers and Chambers, and it largely lost favor among informed research workers, but not among the general public and particularly, not in some management circles.

A factor contributing to the folklore was that accident-proneness theory provided managers of that era with an excuse to blame the employee, rather than sharing responsibility for an accident. Stimulated by misleading reports, and the manager's "need to believe," studies on the theory of accident-proneness proliferated, but unfortunately, most were flawed in their scientific methods. Later, several researchers (Mintz and Blum, 1948; Arbous and Kerrich, 1951) critically reviewed the literature in the field and found a considerable amount of careless reporting, illogical reasoning, and lack of familiarity with the statistical theory underlying the notion of accident proneness. However, faulty conclusions continued to plague the literature and further the misunderstanding of accident-proneness. Much later, Wagenaar and Groeneweg (1987) noted, "Psychologists are talking moonshine if they claim that accident-prone people can be removed through psychological testing." In spite of such warnings, the inclination to believe that psychological testing can be used to identify accident-prone individuals still exists today.

Recently, Hanson (1988) observed that the concept of accident proneness reveals little about how accident-involved workers differ from workers who are accident-free. Efforts to establish a relationship between personality characteristics and accident liability during the last 40 years include over 20 separate research studies. For so many researchers to persist in pursuing the construct of accident proneness, as it relates to personality, without any reliable

results being found, is remarkable, in the least. That level of dedication reveals an unusual persistence in pursuing a specific behavioral concept, particularly with no support from one study to the next. In fact, there are no controlled studies that demonstrated a decrease in accident rates when individuals were screened using psychological tests.

## CURRENT STATUS

It cannot be denied that the idea of accident proneness has a certain intuitive appeal. It seems consistent with some of the experiences that we might have had regarding certain people we have known; that is, some individuals seem to have more than their "fair share" of accidents. However, intuitive appeal cannot replace empirical predictive validity. This is not to say that some personality factors, in combination with many other factors, may not play a role in the occurrence of accidents, but rather that they are limited in their usefulness, particularly as an aid in predicting accidents.

Before accident proneness can be accepted as a stable personality characteristic, it must be measured reliably and then shown to have validity as a predictor. Personality researchers have only recently been able to consistently identify personality trait dimensions (Digman, 1989). Barrick and Mount (1991) have established relationships between these traits and job performance using meta-analysis; however, the use of personality traits to predict the likelihood of accident involvement is still a long way off. The folklore behind the measurement of personality, as it applies to the identification of those who are "prone" to accidents, needs to be replaced by rigorous scientific methods and data. The lack of cross-validation obviates the claims of those noted above who purported to have found scales that predict susceptibility to accidents.

The cross-validation problem is exemplified by a pair of studies conducted by Sanders and Hofmann (1975), in which they investigated the personality aspects in aviation accidents involving pilot error. In the first study, they found that they could correctly

classify 86% of their sample of aviators as to whether they had been previously listed as contributing to a military aviation accident. However, the cross-validation study conducted the following year failed to identify a single personality trait consistently associated with pilots involved in accidents (Sanders, Hofmann, and Neese, 1976).

According to Connolly (1981), the following conclusions about accident proneness appear to be the least assailable. First, there are accident repeaters but inequality of exposure is difficult to exclude as a contributing cause. Second, repeating is possible in a very small number of people; however, repeaters are mostly an ever-changing group. That is, accident repeaters are not a stable component of the workforce, and their identification and removal would not lower accident rates by much. Finally, as already mentioned, psychological testing has not been useful in describing or predicting accident proneness.

## RECOMMENDATIONS

It should be pointed out that it is not the concept of accident proneness that is being questioned in this paper, but rather, the unsubstantiated claims that it is an identifiable constellation of personality traits that can be predicted using psychological tests. There are three fundamental issues that need to be addressed before any meaningful data on accident propensity can be obtained. The first issue is that such research requires a substantial data base for use in conducting a statistical validation analysis where the criterion variable is the number of accidents. Such a data base does not exist, nor is it likely that one can be compiled. Because most people are not involved in multiple accidents, a criterion other than number of accidents would first need to be established, such as incidents or errors, or some other less ultimate criterion measure.

Second, stability over time of the psychological variables used as predictors must be demonstrated. If personality variables are to be used to establish relationships with accident occurrence, a longitudinal study is necessary to ensure that these variables do

indeed remain stable over time. Third, there is the need to account for the impact of situational and circumstantial variables (i.e., differential risk, differential perceived risk, and life events) on the likelihood of an accident occurring. As Alkov, Gaynor, and Borowsky (1985) insightfully noted, "Rather than a chronic lifelong personality trait, we may be dealing with acute situational factors that precipitate risk-taking behavior during certain times of life." Arbous and Kerrich (1951), in an illuminating critique, divided accident-proneness research into two parts; clinical evaluation and statistical analysis. They warned against indiscriminate use of the notion of accident-proneness to explain all cases of repeated accidents; however, they also noted that it cannot be said that no cases of accident proneness exist, and that consideration of the concept, as a clinical phenomenon applied to some individuals, may have some value.

If meaningful results are to be obtained in this area, the three issues noted above must be addressed and resolved satisfactorily. Further, that research must conform to established principles and standards for conducting psychometric studies. Without these conditions being met, there is no purpose whatsoever in continuing to pursue an approach to accident-proneness, characterized by many of the studies reviewed in this paper, and continuing to add to the large body of highly-flawed literature on the subject. Folklore, however intriguing, adds little to the scientific understanding necessary to predict human behavior.

## REFERENCES

- Alkov, R.A., Gaynor, J.A., Borowsky, B.S. (1985). Pilot error as a symptom of inadequate stress coping. *Aviation, Space and Environmental Medicine*, 56:3, 244-277.
- Arbous, A.G. and Kerrich, J.E. (1951). Accident statistics and the concept of accident proneness. *Biometrics*, 7, 340.
- Barrick, M.R., Mount, M.K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personnel Psychology*, 44, 1-27.
- Connolly, J. (1981). Accident proneness. *British Journal of Hospital Medicine*, 26(5), 470-474.
- Digman, J.M. (1989). Five robust trait dimensions: Development, stability, and utility. *Journal of Personality*, 57(2), 195-214.
- Farmers, E. and Chambers, E.G. (1939). A study of accident proneness among motor drivers. *Industrial Health Research Board, Medical Research Council, Report No. 84*. Her Britannic Majesty's Stationary Office, London.
- Greenwood, M. and Woods, H.M. (1919). The incidence of industrial accidents upon individuals with special reference to multiple accidents. *Industrial Fatigue Research Board, Medical Research Committee, Report No. 4*. Her Britannic Majesty's Stationary Office, London.
- Haddon, W., Suchman, E.A., and Klein, D. (1964). *Accident Research*. N.Y.: Harper & Row.
- Mintz, A., and Blum, M.L. (1949). A re-examination of the accident proneness concept. *Journal of Applied Psychology*, 33, 195-211.
- Newbold, E.M. (1926). A contribution to the study of the human factor in the causation of accidents. Report No. 34. *Industrial Health Research Board*, London.
- Sanders, M.G., and Hofmann, M.A. (1975). Personality aspects of involvement in pilot-error accidents. *Aviation, Space, and Environmental Medicine*, 46(2), pp. 186-190.
- Sanders, M.G., Hofmann, M.A., and Neese, T.A. (1976). Cross-validation study of the personality aspects of involvement in pilot-error accidents. *Aviation, Space, and Environmental Medicine*, 42(2), pp. 177-179.
- Wagenaar, W.A., and Groeneweg, J. (1987). Accidents at sea: Multiple causes and impossible consequences. *International Journal of Man-Machine Studies*, 27, 587-598.